

Analysis of Fertilizer Treatments on the National Elk Refuge, 1999

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Abstract

Simplot Soilbuilders of Mountain Dell, Idaho applied fertilizer treatments on 217 total acres on April 20, 1999. They applied two treatments (80-20-20-20 and 80-20-0-20) to three fields (McBride Intermediate Wheatgrass field, the McBride Brome/Alfalfa field, and the Peterson brome mixed grass field). Each field also contained a one acre unfertilized control for a total of 3 treatments/field ($n=9$ treatment units). Each field was flood irrigated during the growing season. I measured forage production and took hay quality samples to measure crude protein, digestible protein, digestible dry matter, digestible energy, total digestible nutrients, quality factor and price factor in each of the 9 treatment units in September–October, 1999. I used a randomized complete block design, and analysis of variance to determine if there was any significant difference (alpha = 0.05) in forage production and the hay quality variables among treatments. Although no results were statistically significant, forage production was consistently higher in fertilized areas compared to controls in each field (range 1.3 - 4.0 times higher). There was no difference in forage production between the 80-20-0-20 and the 80-20-20-20 fertilizer treatments. There were no consistent differences between treatments or between treatments and controls for any of the hay quality variables. The 80-20-0-20 treatment should be considered in the future to increase forage production on irrigated fields. Further experimentation will be needed to evaluate other fertilizer treatments and determine if fertilizer treatments will increase production in non-irrigated areas.

Hypotheses Tested

I hypothesized that fertilizer application would increase forage production and hay quality compared to unfertilized areas. I further hypothesized that application of 80-20-20-20 would improve forage production and hay quality compared to 80-20-0-20.

Methods

Fertilizer Application

Simplot Soilbuilders of Mountain Dell, Idaho applied fertilizer treatments on 217 total acres on April 20, 1999 using a boom sprayer. Mean daily temperature at the time of application was 47 F, with light winds. There was an inch of precipitation the following day. They applied two treatments (80-20-20-20 and 80-20-0-20). Each number in the formula refers to application rate in pounds/acre for nitrogen, phosphorous, potassium and sulfur. For example the 80-20-20-20 application was 80 pounds of nitrogen, 20 pounds of phosphorous, 20 pounds of potassium, and 20 pounds of sulfur per acre. The 80-20-0-20 application was the same but contained no potassium. More detailed information on the exact chemical composition of the applications is available in the hardcopy files. They applied each of the two fertilizer treatments to a portion of 1) the McBride intermediate wheatgrass field, 2) the McBride brome/alfalfa field immediately south of field number 1, and 3) the Peterson brome/mixed grass field (Figures 1a and 1b). Each field also contained a one acre unfertilized control for a total of 3 treatments/field ($n=9$ treatment areas).

Forage Production and Hay Quality Sampling

I selected a systematic random point within each treatment area to sample forage production and hay quality. Sample points could not be completely random for the following reasons: 1) Flood irrigation was not consistent across all treatment areas in the McBride intermediate wheatgrass field, and 2) The plant community and species composition in the control portion of the Peterson brome/mixed grass field was not comparable to all other portions of that field. Since we were most interested in the effects of fertilizer treatments, sample plots in each treatment area had to be in an area of similar species composition and flood irrigation as other treatment areas within that field. Each of the fields in this study were flood irrigated during the 1999 growing season, but due to problems with head gates, the control portion of the McBride intermediate wheatgrass field received less water than the treated portions of the field. To allow for comparable levels of flood irrigation, the sample plot in the control area was placed along the supply irrigation ditch. This area was sub-irrigated from the ditch, and received irrigation that was comparable to

other treatment areas in this field. In the Peterson field, the control was located in a low-elevation area with more bluegrass and forbs than most portions of the field. For this reason, the sample plots for the two fertilized areas were also placed in comparable low-elevation portions of the field with similar species composition.

Brian Viallobos and I sampled forage production in each treatment area using the same SCS double sampling method used for other forage production sampling on the Refuge. Hay test samples were taken near forage production plots in each treatment area in mid October. Since cured hay quality is of greatest interest to the Refuge, I took hay test samples later in the year than for forage production sampling. Hay samples were sent to Bar Diamond Laboratories in Parma, Idaho for analysis of crude protein, digestible protein, digestible dry matter, digestible energy, total digestible nutrients, quality factor and price factor.

Statistical Analyses

I used a randomized complete block design where each field was a replicate block. With this design, comparison of the effects of the different treatments on forage production and the hay quality variables is made within each field. This design accounts for variability among fields in flood irrigation, soil quality and species composition. I used analysis of variance (SYSTAT procedure GLM with treatment by field as the explanatory variable) to determine if there was any significant difference ($\alpha = 0.05$) in the variable of interest among treatments and the control. A separate analysis was conducted using forage production and each of the hay quality variables as the response. If the analysis of variance was found to be significant for a given variable, then paired t-tests would be used to compare each of the two treatments and each of the treatments to the control.

Results

None of the analyses of variance were statistically significant ($\alpha = 0.05$) for any response variable. However, forage production in both of the fertilizer treated areas was higher than the control in each of the 3 fields (Table 1). Forage production was 1.3-4.0 times greater than controls using the 80-20-0-20 treatment, and 1.7-2.8 times greater than controls using the 80-20-20-20 treatment. Forage production was not consistently higher in 80-20-20 treated areas compared to 80-20-0-20 treated areas. There were no consistent trends for any of the hay quality variables (Table 1).

Conclusions and Management Recommendations

Although not statistically different, forage production in fertilized areas was higher compared to areas that were not fertilized in each of the three fields. The lack of statistical difference is due to sample size limitations, and there is a biological effect. We can conclude that both the 80-20-0-20 treatment with irrigation and the 80-20-20 treatments with irrigation increased forage production 2.3 times that of irrigation alone. However, since there was no consistent difference in production between the two fertilizer treatments, we can conclude that the application of twenty pounds of potassium per acre did not produce more forage than the application of nitrogen, phosphorus and sulfur alone. Neither fertilizer treatment produced any increase in hay quality compared to controls. Hay quality appears to be more related to species composition than fertilizer treatment.

Based on these conclusions, I recommend more trial applications of 80-20-0-20 on irrigated fields to increase forage production. We should also take soil samples this spring and try other fertilizer applications based on the soil sample results. Further experimentation will be needed to evaluate other fertilizer treatments and determine if fertilizer treatments will increase production in non-irrigated areas. We should compare elk and bison utilization in fertilized versus control areas during the regular utilization inventory this spring.

Figure 1a. Relative location of fertilized fields and fertilizer treatments in the McBride management unit, and location of treatment types within fields.

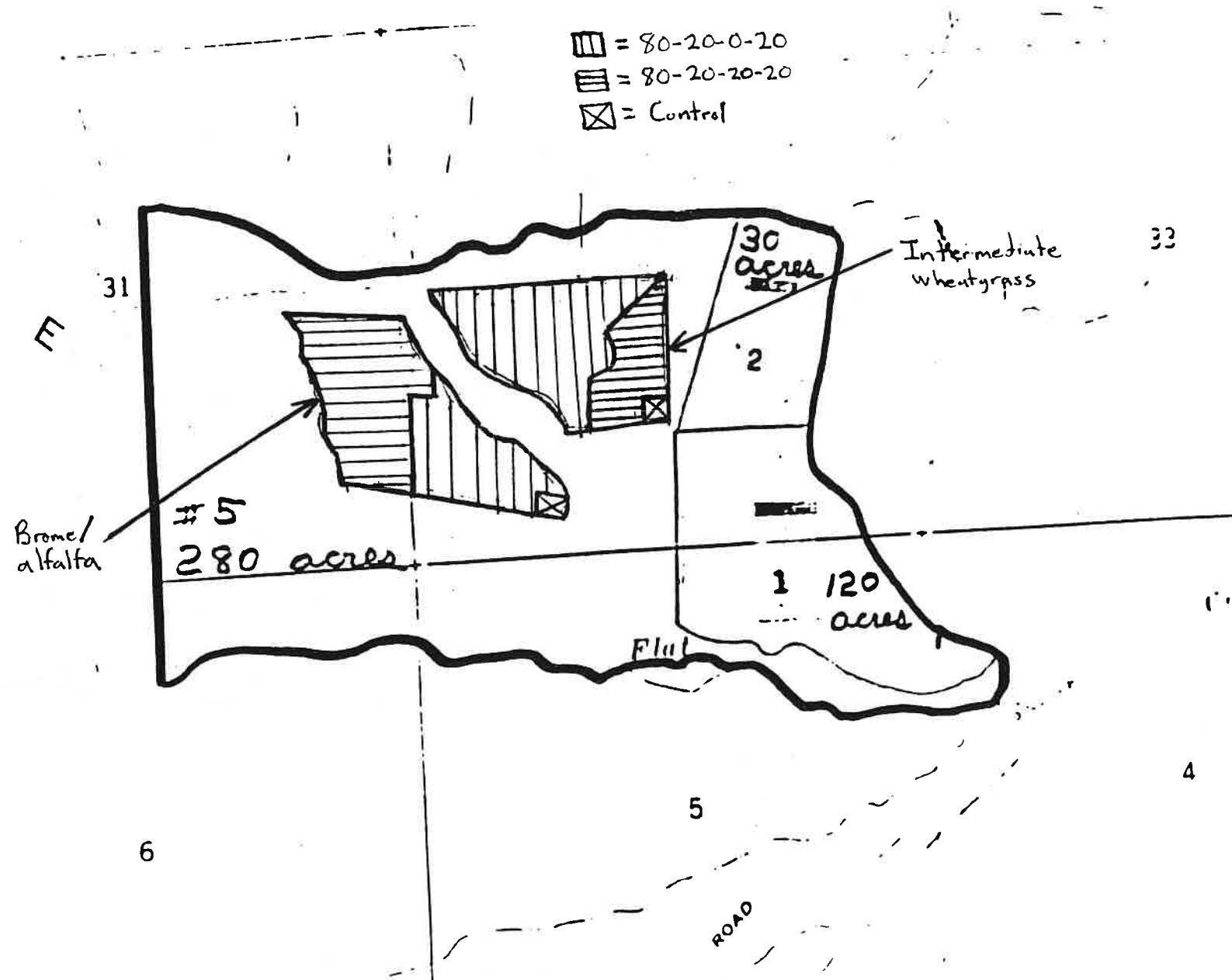


Figure 1b. Location of fertilized field in the Peterson management unit, and location of treatment types within the field.

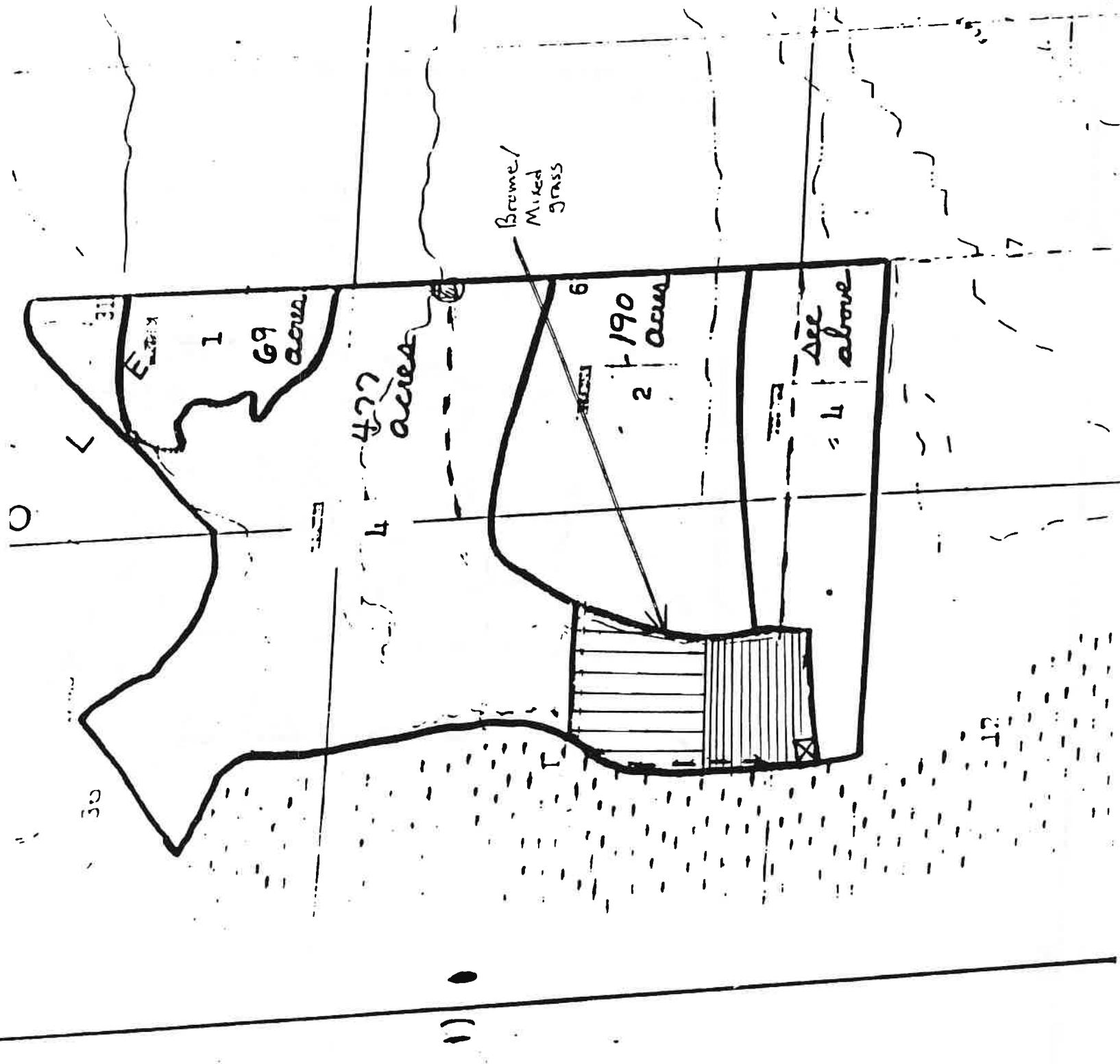


Table 1. Estimated production (lbs/acre), crude protein (%), digestible protein (%), digestible dry matter (%), digestible energy (Mcal/kg), total digestible nutrients (%), quality factor (%) and price (%) for each fertilizer treatment in each field, NER 1999.

Field	Treatment	Production	Crude Protein	Digestible Protein	Digestible Dry Matter	Digestible Energy	TDN	Quality	Price
McB. Int Wheat	80-20-0-20	8934	6.16	2.77	56.27	2.38	50.90	0.88	0.91
McB. Int Wheat	80-20-20-20	6397	3.73	0.63	55.25	2.34	49.92	0.87	0.91
McB. Int Wheat	Control	2260	4.56	1.36	57.02	2.41	51.63	0.89	0.94
McB. Brome	80-20-0-20	4104	7.83	4.23	52.44	2.22	47.20	0.82	0.86
McB. Brome	80-20-20-20	4019	6.48	3.05	50.26	2.12	45.1	0.79	0.82
McB. Brome	Control	2746	7.24	3.71	50.52	2.14	45.35	0.79	0.82
Peterson	80-20-0-20	2335	5.34	2.05	57.59	2.44	52.17	0.90	0.94
Peterson	80-20-20-20	3093	7.07	3.56	58.54	2.48	53.09	0.92	0.95
Peterson	Control	1860	8.41	4.73	61.11	2.59	55.57	0.96	0.99

**Supplement to 1999 Fertilizer Application Testing: Effects of Fertilizer Application
on Forage Utilization**

Table 1. Forage utilization as determined by Parker frequency of use method for each fertilizer treatment in each field. Fertilized April 1999 and sampled for utilization in April 2000, National Elk Refuge.

Field	Treatment	Percent Utilization
McB. Int. Wheat.	80-20-0-20	94
	80-20-20-20	96
	Control	88
McB. Brome	80-20-0-20	84
	80-20-20-20	88
	Control	88
Peterson	80-20-0-20	74
	80-20-20-20	68
	Control	72

I see no need for statistical test by ANOVA. There is obviously no difference in forage utilization among the different treatments within the fields.